

1. (15 pts ea) For the following relations on $S = \{0, 1, 2, 3, 4\}$ specify whether it is reflexive, anti-reflexive, symmetric, anti-symmetric and/or transitive. Be sure to explain (show/prove) why or why not for all five characteristics.
 - (a) The relation R given by $(m, n) \in R$ if $m + n = 5$
 - (b) The relation C where mCn if $m + n \in S$

2. (6 pts) On the set $\mathbb{N} \times \mathbb{N}$, $(m, n) \sim (k, l)$ if $m + l = n + k$ defines an equivalence relation.
 - (a) Give 3 other elements in the same equivalence class as $(0, 0)$ (i.e. 3 elements which are not $(0, 0)$).
 - (b) List 3 other elements in $[(1, 4)]$.

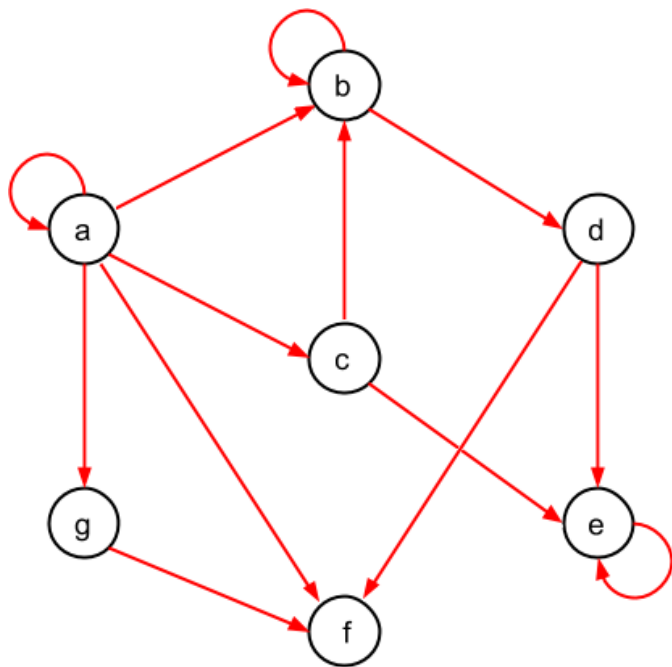
3. (15 pts) Let $X = \{a, b, c, d, e\}$ and define the relation R on $\mathcal{P}(X)$ as $(A, B) \in R$ if $A \cap B = \emptyset$. Determine whether the relation R is reflexive, anti-reflexive, symmetric, anti-symmetric and/or transitive

4. (10 pts) Consider the relation \bullet on \mathbb{Z} defined by $a \bullet b$ if $a - b$ is even. Determine whether the relation is an equivalence relation.

5. (5 pts) Consider the function $f : \mathbb{N} \rightarrow \mathbb{N}$ given by $f(n) = \lfloor \frac{n+1}{2} \rfloor + \lceil \frac{n}{2} \rceil$. What is the image of f ? Explain.

6. (13 pts) Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = x^4 - x^2 - 4$.
 - (a) What is $f^{-1}(-4)$?
 - (b) What is $f^{-1}(2)$?
 - (c) What is $f^{-1}(-6)$?
 - (d) Determine (with reasoning) the image of f .
~~Is f one-to-one? Why/why not?~~
~~Is f onto? Why/why not?~~

7. (14 pts) The diagram below shows a directed graph.



Determine the out-degree and the in-degree of each vertex.

vertex	out-degree	in-degree
a		
b		
c		
d		
e		
f		
g		